



WELCOME TO NASA APPLIED REMOTE SENSING TRAINING (ARSET) WEBINAR SERIES

INTRODUCTION TO REMOTE SENSING FOR WILDFIRE APPLICATIONS

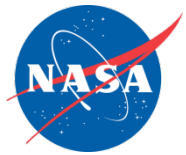
**COURSE DATES: EVERY TUESDAY, MARCH 31- APRIL 28
TIME: 11:30 AM-12:30 PM EST**



Important Information

- One lecture per week – every Tuesday from March 31 to April 28 (11:30 AM – 12:30 PM EST)
- Webinar recordings, PowerPoint presentations, and homework assignments can be found after each session at:
<http://arset.gsfc.nasa.gov/disasters/webinars/introduction-remote-sensing-wildfire-applications>
- Certificate of Completion
 - ▣ Attend 4 out of 5 webinars
 - ▣ Assignment 1 and 2 – access from the ARSET wildfire webinar website (above)
 - ▣ You will receive certificates approximately 1 month after the completion of the course from: marines.martins@ssaihq.com
- Q/A: 15 minutes following each lecture and/or by email (cynthia.l.schmidt@nasa.gov)

ARSET Wildfire Management



<http://arset.gsfc.nasa.gov/eco/webinars/land-management>



Registration: <https://arset.adobeconnect.com/wildfire/event/registration.html>

Agenda:  [NASA_ARSET_Wildfire_Webinar_Agenda.pdf](#)

Keywords: **Ecosystems, Fires and Smoke, Satellite Imagery, Vegetation Indices**

Instruments/Missions: **Landsat, MODIS, NPP, SMAP, VIIRS**

Presentations and Recordings

Week	Date	Title	Presentation	Recording	Assignment
1	March 31, 2015	Overview of remote sensing	 Week 1 Presentation  Week 1 Presentation (Spanish)	View Week 1 Recording	N/A
2	April 7, 2015	Satellite sensors and data products for wildfire applications	Week 2 Presentation Week 2 Presentation (Spanish)	View Week 2 Recording	Assignment 1
3	April 14, 2015	Remote sensing products for pre- and post-fire wildfire planning and assessment	Week 3 Presentation Week 3 Presentation (Spanish)	View Week 3 Recording	N/A



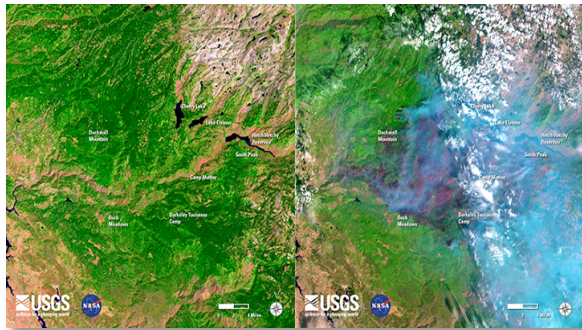
Your Course Instructors

- Cindy Schmidt (ARSET): cynthia.l.schmidt@nasa.gov
- Amber Kuss (ARSET): amberjean.m.kuss@nasa.gov
- Guest Speakers:
 - Tony Guay – USDA Forest Service Remote Sensing Applications Center (week 3)
 - Keith Weber – Idaho State University (week 3)
 - Dale Hamilton – Northwest Nazarene University (week 4)
 - Mark Carroll – NASA Goddard (week 4)
 - Lindsey Harriman and Kelly Lemig – LP DAAC (week 5)
lharriman@usgs.gov, klemig@usgs.gov

General inquiries about ARSET: Ana Prados (ARSET)
aprados@umbc.edu

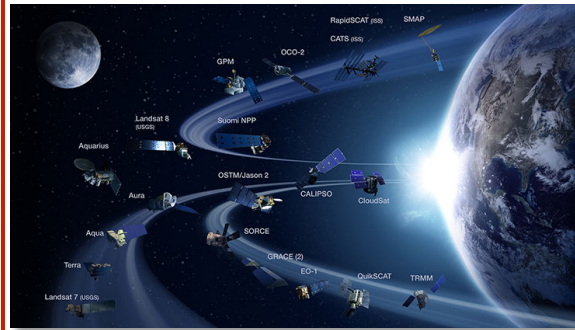
Course Outline

Week 1



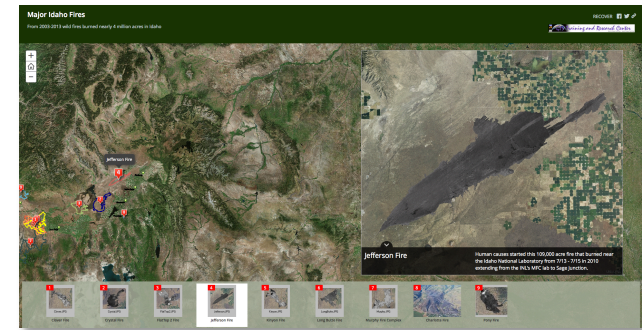
Overview of satellite remote sensing

Week 2



Platforms and sensors for wildfire applications

Week 3



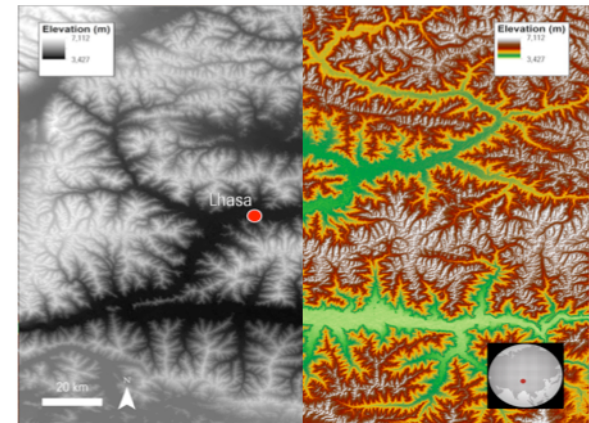
Products and tools for pre and post-wildfire

Week 4



New techniques and technologies

Week 5



Terrain data applications



Week 2 Agenda

- ❑ Brief review of last week
- ❑ Satellite data processing levels
- ❑ Overview of satellite sensors for wildfire applications
- ❑ Satellite products and tools for data access
- ❑ Live Demos:
 - ❑ FIRMS MODIS active fires
 - ❑ Worldview



Review of Week 1

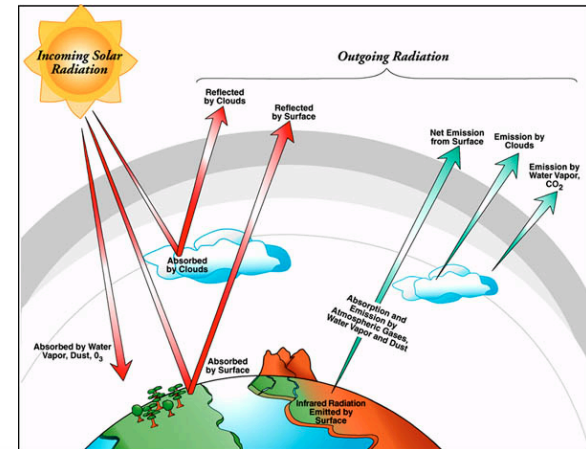
Wildfires: Global Critical Issues

- ❑ Loss of human life and property
- ❑ Air pollution
- ❑ Habitat loss
- ❑ Hydrological regime changes and increased risk of landslides
- ❑ Increased frequency, duration, and severity due to fire suppression methods and climate change



Fundamentals of Remote Sensing

- ❑ Remote Sensing
 - ❑ Electromagnetic spectrum
 - ❑ Spectral signatures
 - ❑ Advantages/
Disadvantages
- ❑ Characteristics of satellite sensors
 - ❑ Passive vs. active
- ❑ NASA satellites for wildfire applications



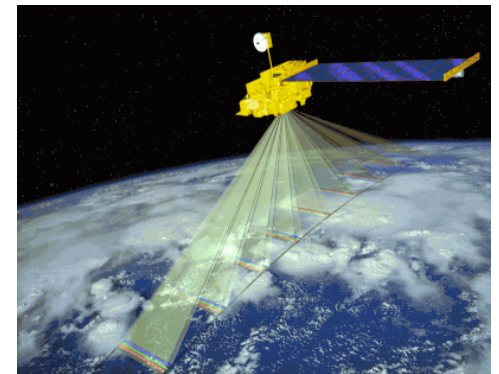
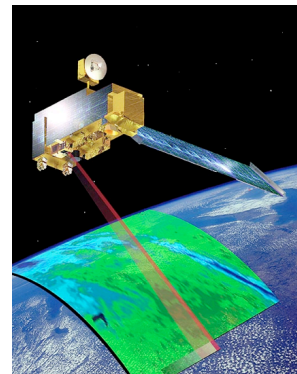
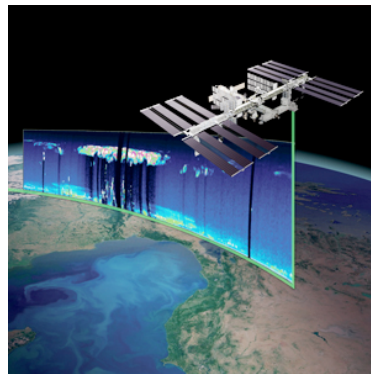
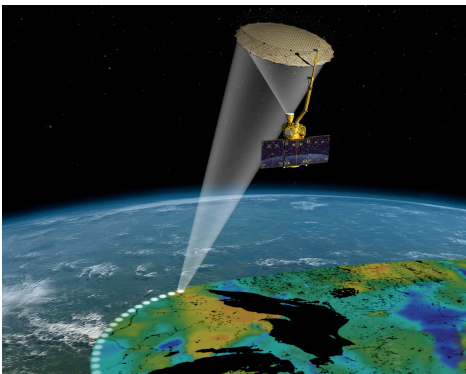


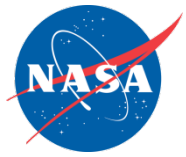
Satellite Data Processing Levels

Levels of Data Processing and Spatial Resolution

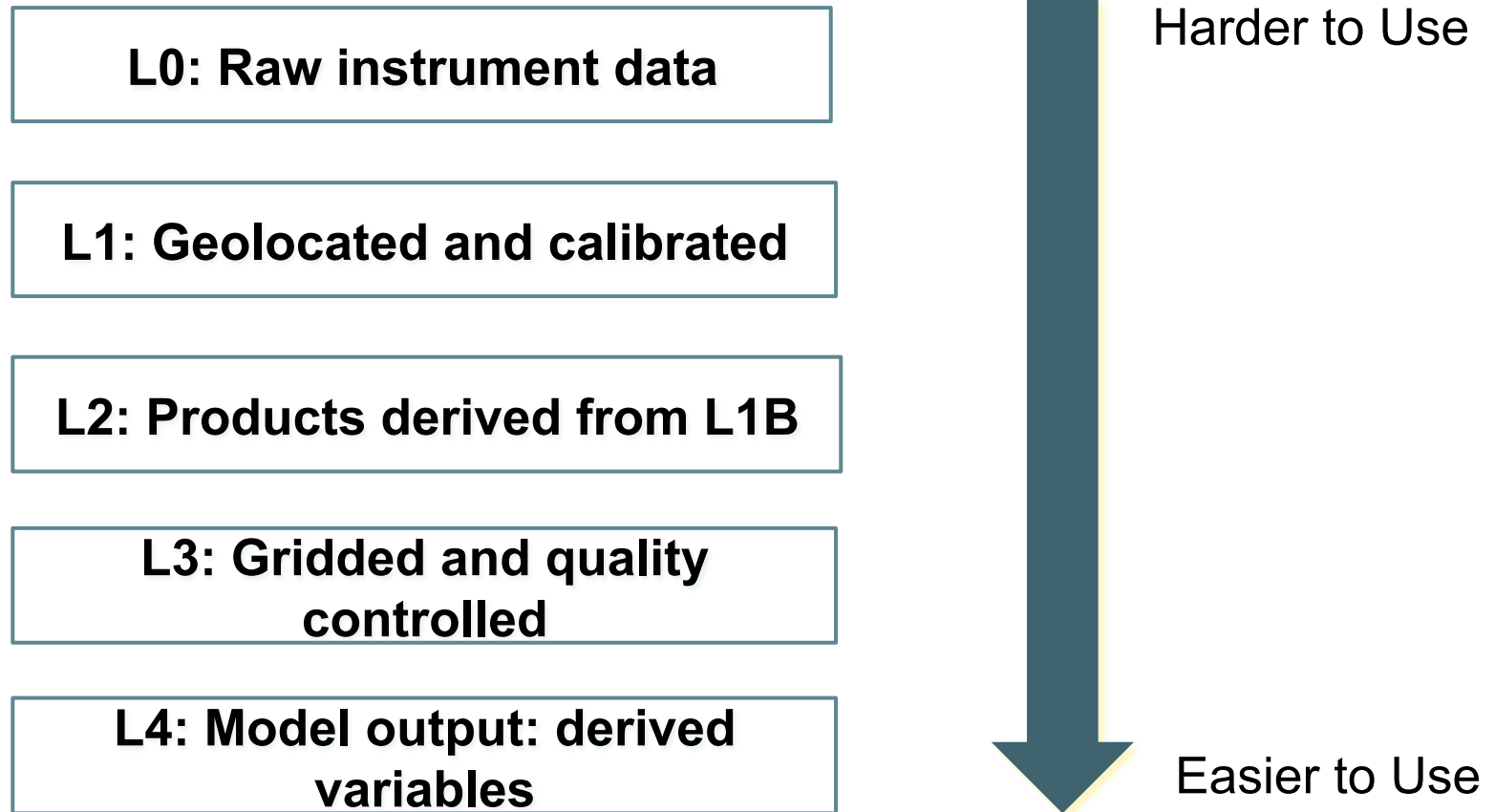


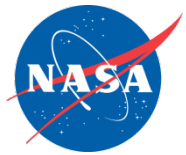
- ❑ **Level 1 and Level 2** data products have the highest spatial and temporal resolution.
- ❑ **Level 3 and 4 products** are derived products with equal or lower spatial and temporal resolution than Level 2 products.





Data Processing Levels





Data Processing Levels

Landsat	MODIS
Level 1T – Standard Terrain Corrected	Level 2 – derived geophysical variables
Level 1Gt – Systematic Terrain Correction	Level 2G – level 2 data mapped on a uniform space-time grid scale
Level 1G – Systematic Correction	Level 3 – gridded variables in derived spatial and/or temporal resolutions
	Level 4 – model output or results from analyses of lower level data

Landsat: Use level 1 imagery that includes spectral characteristics

MODIS: Use level 2, 3, or 4 products

For more information on Landsat data processing levels:

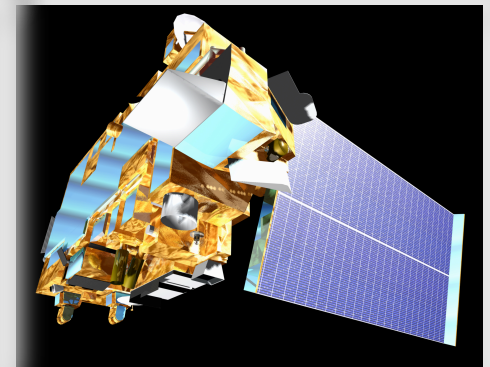
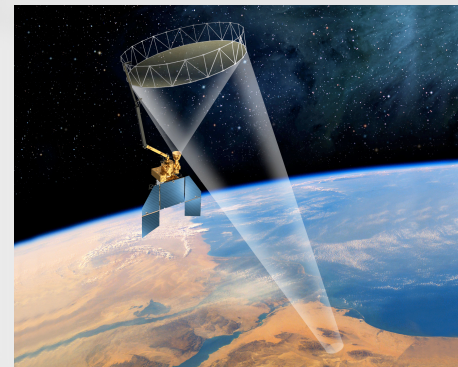
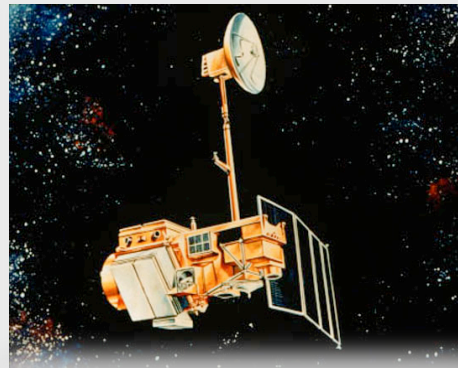
http://landsat.usgs.gov/Landsat_Processing_details.php

For more information on MODIS Land Products processing levels:

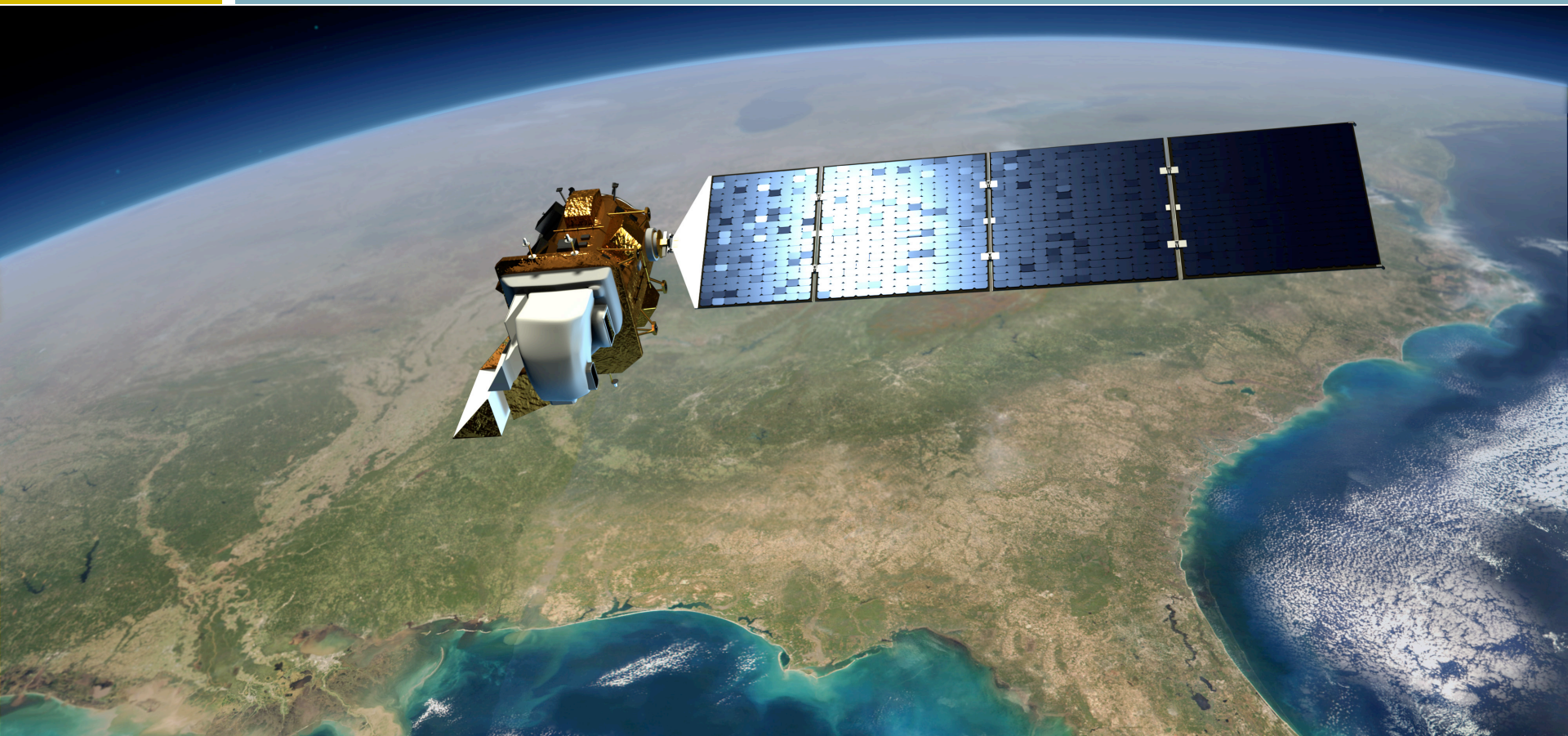
http://lpdaac.usgs.gov/products/modis_products_table/modis_overview

Wildfire Satellites and Sensors

- ❑ Brief Overview (History and Current Missions)
- ❑ Characteristics of the Data
- ❑ Where to Obtain Images
 - ❑ Landsat
 - ❑ MODIS
 - ❑ SMAP

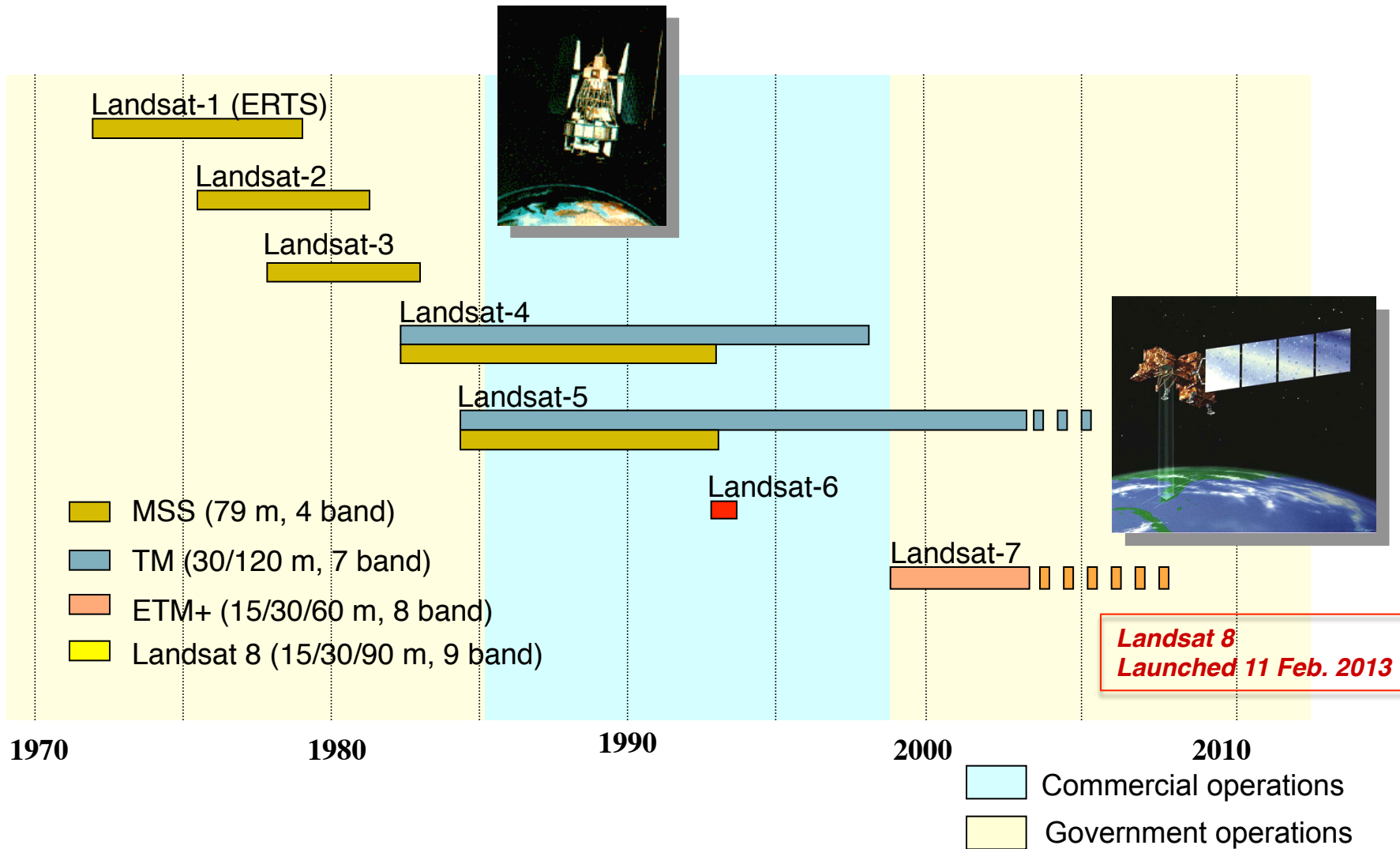


Landsat



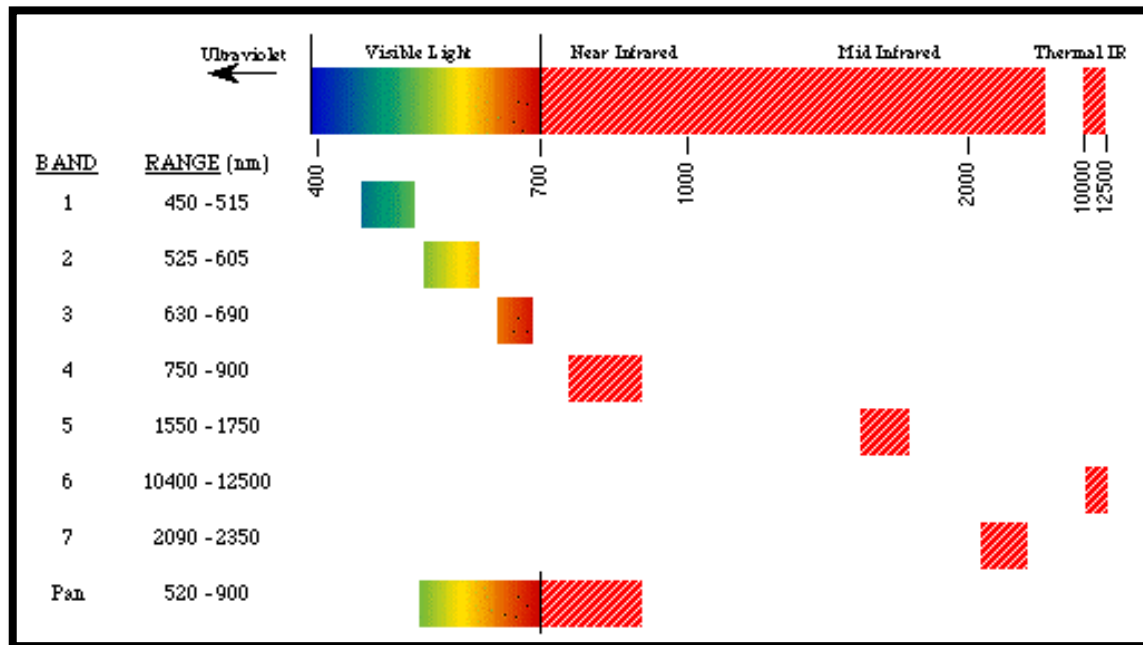


Landsat: 30 Years of Observations



Characteristics of Landsat: Spectral

- ❑ Landsat instruments measure primarily light that is reflected from Earth's surface (with one exception)
- ❑ Landsat instruments are designed to detect visible and infrared (near and mid) wavelengths.



Landsat bands
of ETM+
(Landsat 7)

Source: NASA Goddard Space Flight Center



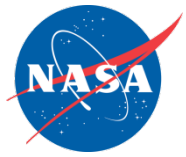
Characteristics of Landsat 4, 5 and 7

Bands	Wavelength (micrometers)	Resolution (m) Landsat 4-5 (TM)	Resolution (m) Landsat 7 (ETM+)
Band 1-Blue	0.45-0.52	30	30
Band 2 Green	0.52-0.60	30	30
Band 3- Red	0.63-0.69	30	30
Band 4-Near Infrared	0.76-0.90	30	30
Band 5- Shortwave Infrared 1	1.55-1.75	30	30
Band 6- Thermal Infrared	10.40-12.50	120	60
Band 7- Shortwave Infrared 2	2.08-2.35	30	30
Band 8-Pan	0.52-0.90	--	15



Characteristics of Landsat 8

Bands	Wavelength (micrometers)	Spatial Resolution (meters)
Band 1-Coastal aerosol	0.43-0.45	30
Band 2- Blue	0.45-0.51	30
Band 3- Green	0.53-0.59	30
Band 4- Red	0.64-0.67	30
Band 5- Near Infrared	0.85-0.88	30
Band 6- SWIR 1	1.57-1.65	30
Band 7- SWIR 2	2.11-2.29	30
Band 8-Panchromatic	0.50-0.68	15
Band 9-Cirrus	1.36-1.38	30
Band 10- Thermal Infrared 1	10.60-11.19	100
Band 11- Thermal Infrared 2	11.50-12.51	100

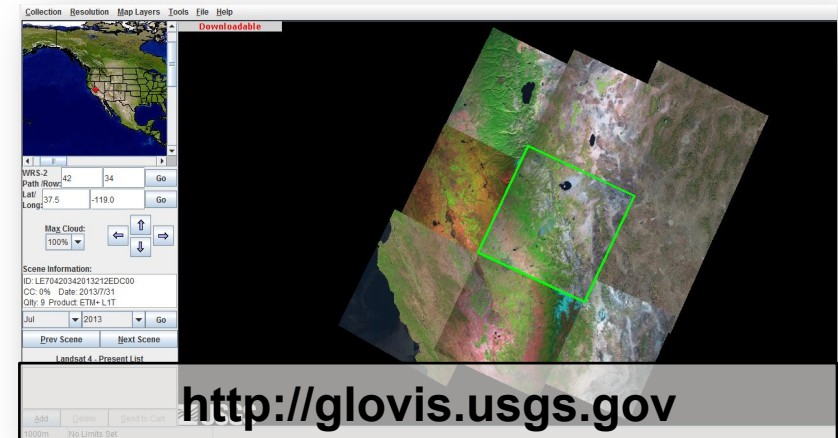


Where to Obtain Landsat Images

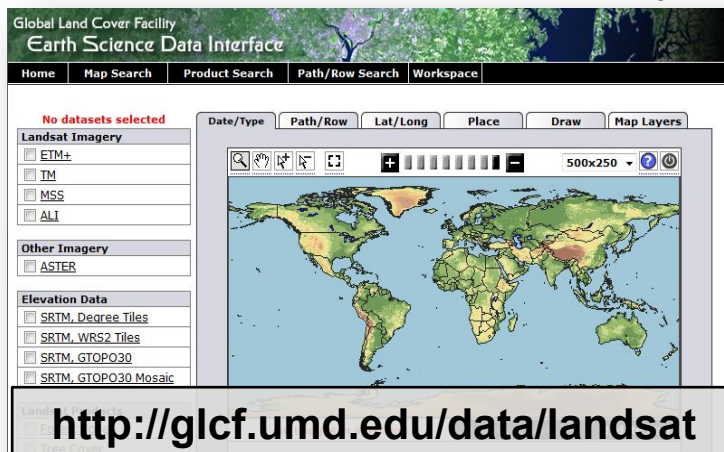
The LandsatLook Viewer



GloVis



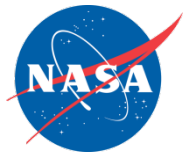
Global Land Cover Facility



Earth Explorer



Where to Obtain Landsat Images and Products



WELD

WELD: WEB - ENABLED LANDSAT DATA

Available Years:

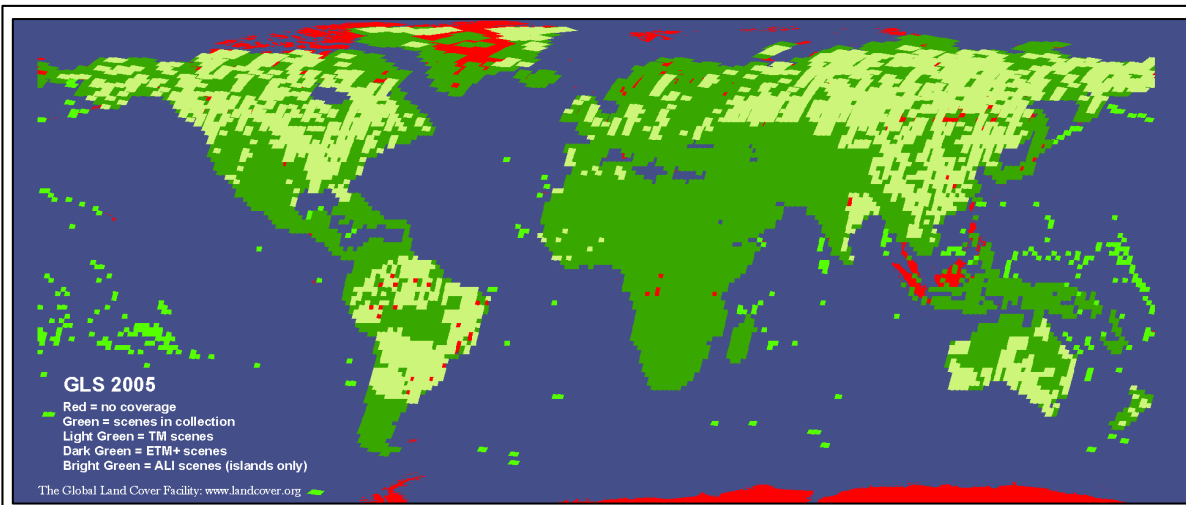
CONUS

Alaska

<http://weld.cr.usgs.gov>
<http://globalweld.cr.usgs.gov>

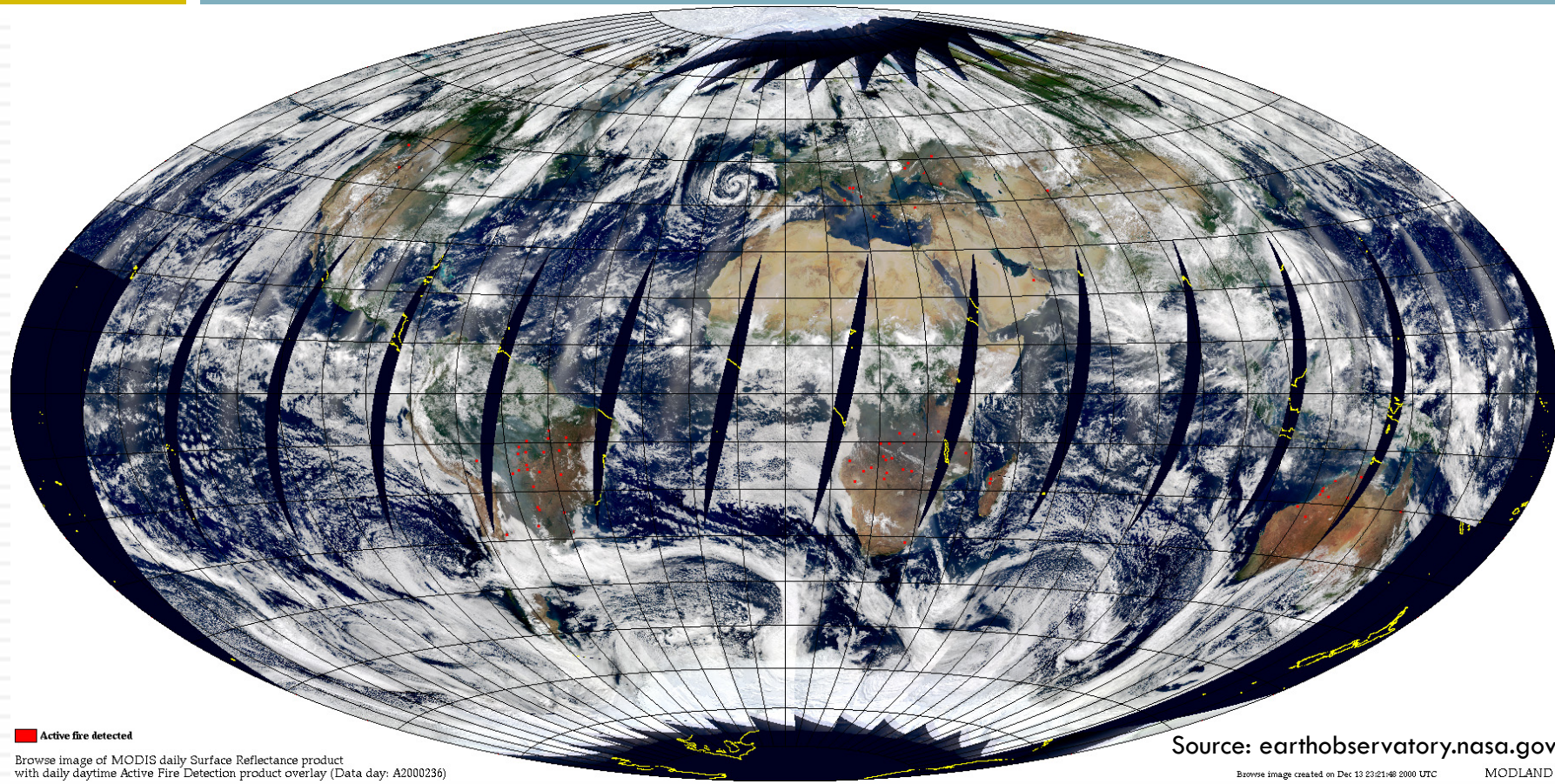
Landsat Global Archive Consolidation (USGS)

http://landsat.usgs.gov/Landsat_Global_Archive_Consolidation.php

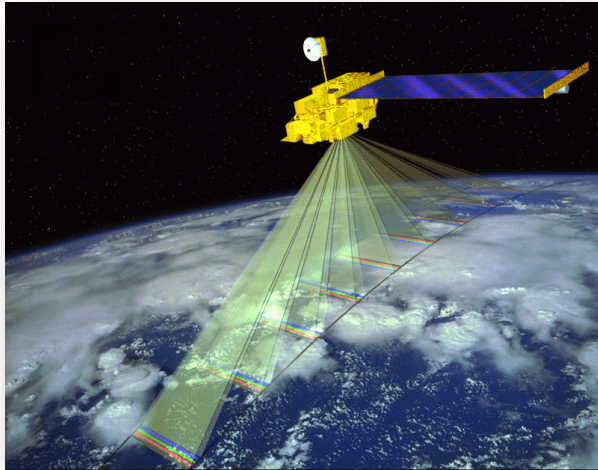


- Global Land Survey
- Not a data portal, but a global collection of cloud free Landsat images from 1975-2008.
- Time series include (GLS 1975, GLS 1990, GLS 2000, GLS 2005, GLS 2010)
- Acquire GLS datasets through Earth Explorer, GloVis, and GLCF

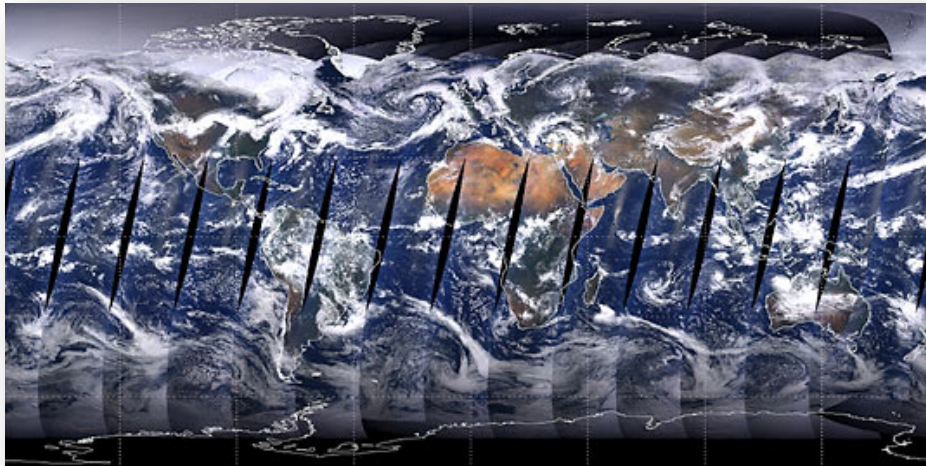
MODIS



MODIS (Moderate Resolution Imaging Spectroradiometer)



- ❑ Spatial Resolution
 - ❑ 250m, 500m, 1km
- ❑ Temporal Resolution
 - ❑ Daily, 8-day, 16-day, monthly, quarterly, yearly
 - ❑ 2000-present
- ❑ Data Format
 - ❑ Hierarchical data format – Earth Observing System Format (HDF-EOS)

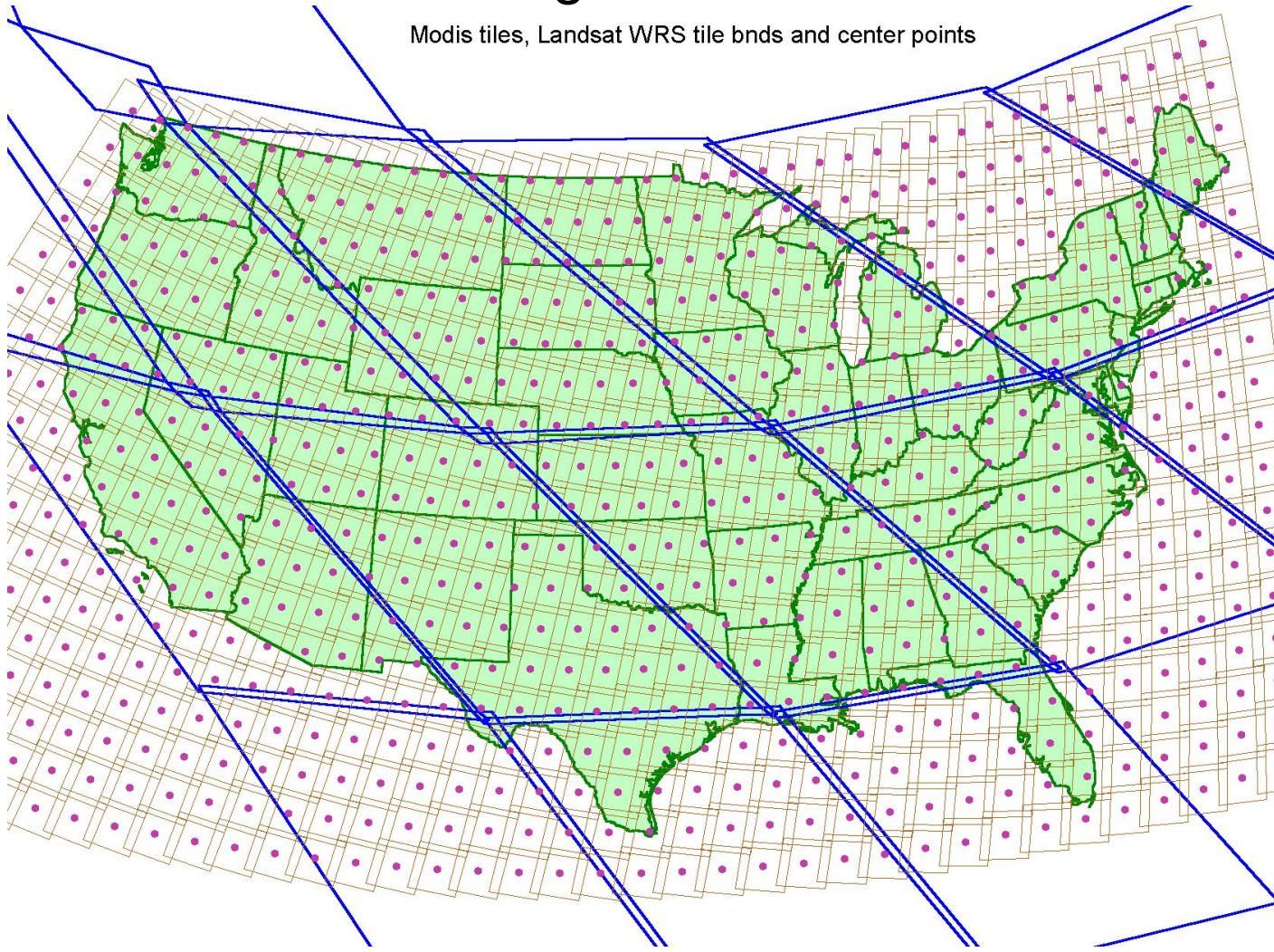


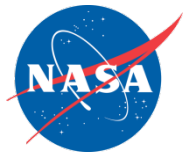
- ❑ Spectral Coverage
 - ❑ 36 bands (major bands include Red, Blue, IR, NIR, MIR)
 - Bands 1-2: 250m
 - Bands 3-7: 500m
 - Bands 8-36: 1000m

MODIS Tiles vs. Landsat Images

Large swaths!

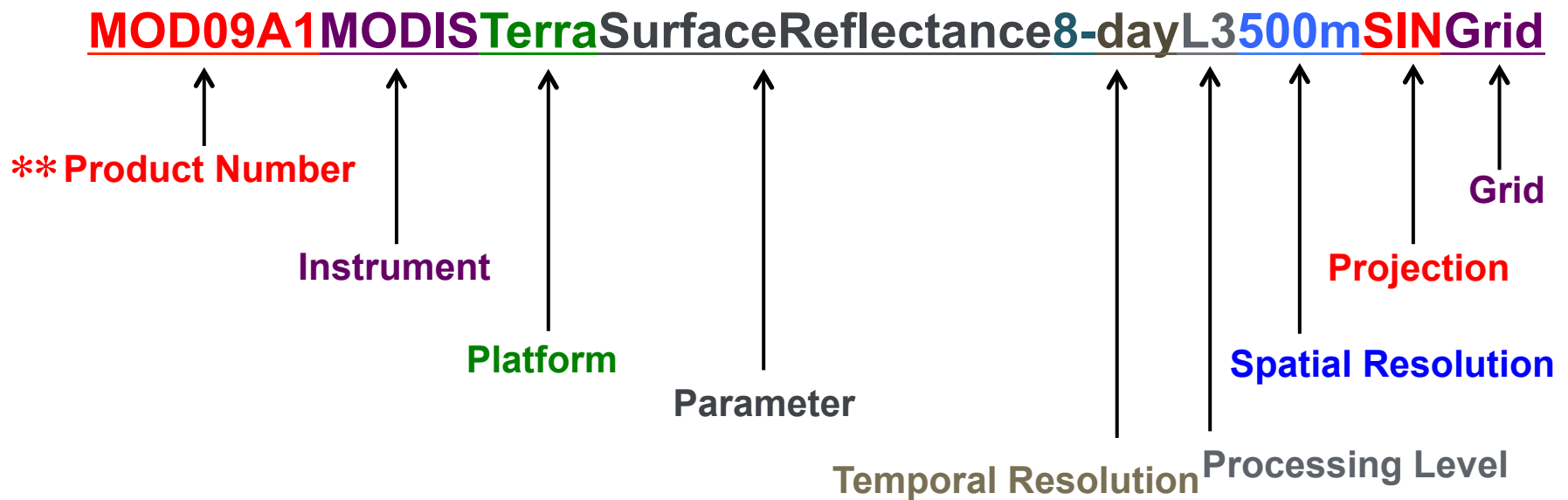
Modis tiles, Landsat WRS tile bnds and center points



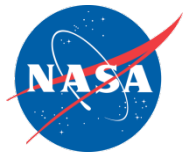


MODIS Naming Convention

MODIS filenames follow a naming convention which gives useful information regarding the specific product. For Example:



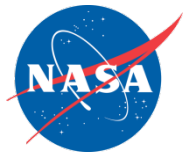
****NOTE: MOD – Terra; MYD – Aqua; MCD - Combined**



MODIS Land Products

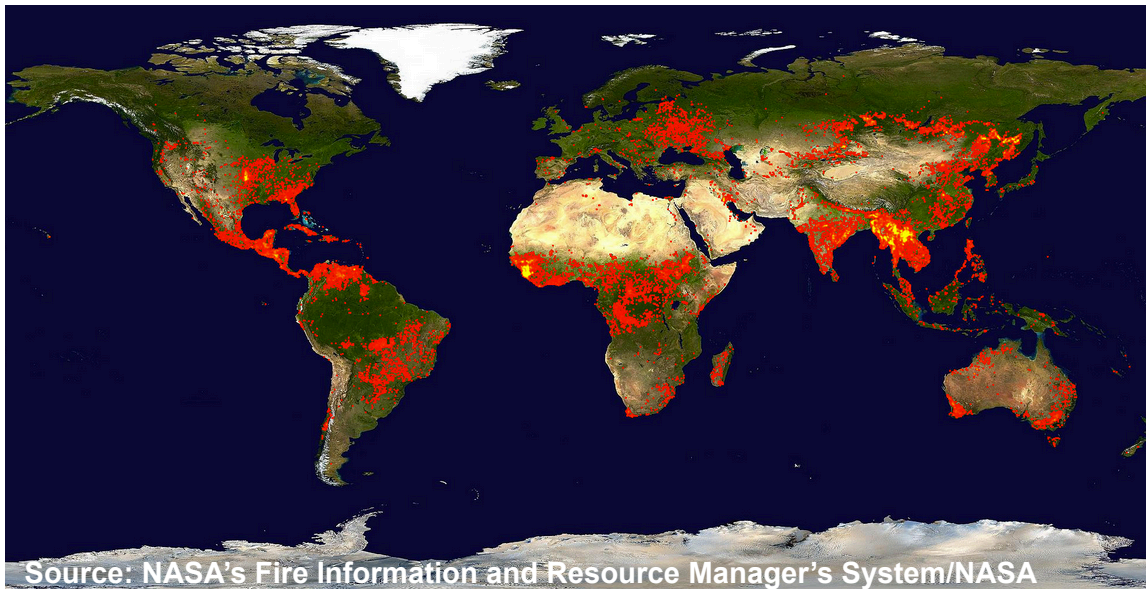
MODIS Name	Product Name Short name	Spatial Resolution (m)	Temporal
MOD 09	Surface Reflectance	500	8-day
MOD 11	Land Surface Temperature	1000	Daily, 8-day
MOD 12	Land Cover/Change	500	8-day, Yearly
MOD 13	Vegetation Indices	250-1000	16 day, monthly
MOD 14	Thermal Anomalies/Fire	1000	Daily, 8-day
MOD 15	Leaf Area Index/Fraction of Absorbed Photosynthetically Active Radiation (FPAR)	1000	4-day, 8-day
MOD 16	Evapotranspiration		
MOD 17	Primary Production	1000	8-day, yearly
MOD 43	Bidirectional reflectance distribution function (BRDF)/Albedo	500-1000	16-day
MOD 44	Vegetation Continuous Fields	250	yearly
MOD 45	Burned Area	500	monthly

❑ All MODIS Land Products are available at processing Level 3



MODIS Land Products: Thermal Anomalies (MYD14A1)

- ❑ Provides snapshots of active burning fires and burned areas
- ❑ The Active Fire product delivers actively burning locations on a daily basis at 1km resolution (additional 8 day and monthly products)
- ❑ Fire product includes multiple attributes such as fire mask, fire pixel table, and maximum fire radiative power
- ❑ The Thermal Anomalies product detects other thermal anomalies such as volcanic signatures



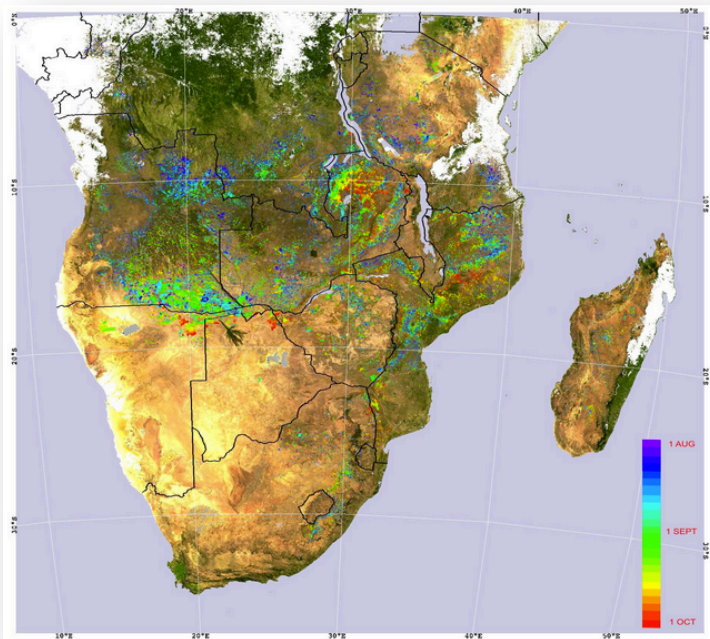
**Global Fire Map
(April 1-10, 2014)**

Source: NASA's Fire Information and Resource Manager's System/NASA

MODIS Land Products: Burned Area (MCD45A1)



- ❑ The combined Terra & Aqua MODIS Burned Area Product is a monthly gridded 500m product
- ❑ MODIS detects the approximate date of burning at 500m resolution
- ❑ For more information: <http://modis-fire.umd.edu>



Example of the MODIS 500 m burned area product for sub equatorial Africa. The different colors indicate the approximate day of the burning detected between August and October in 2000.

Image courtesy of MODIS Fire Team

Where to Obtain Information on MODIS (and other) NASA Products



- ❑ Land Processes Distributed Active Archive (LP DAAC)
 - ❑ https://lpdaac.usgs.gov/products/modis_products_table
- ❑ Earth Observing System Data and Information System (EOSDIS):
 - ❑ <http://Earthdata.nasa.gov>

The screenshot displays the Earthdata.nasa.gov website. At the top, there are six circular icons representing different Earth system components: ATMOSPHERE, CALIBRATED RADIANCE AND SOLAR RADIANCE, CRYOSPHERE, HUMAN DIMENSIONS, LAND, and OCEAN. Below these icons, the website is divided into several sections. On the left, there is a 'Earthdata News Feeds' section with a list of data centers: GES-DISC, GHRC, LaRC ASDC, LP DAAC, NSIDC DAAC, ORNL DAAC, PO DAAC, SEDAC, GCMD, and ESIIP Federation. Below this is an 'Events Calendar' section listing upcoming events such as the 2014 Gregory G. Leptoukh 2nd Annual Online Giovanni Workshop, the American Geophysical Union (AGU) Fall Meeting, and the Federation of Earth Science Information Partners (ESIP) Winter Meeting. The main content area is titled 'EOSDIS News' and 'Sensing Our Planet'. It features several news items with accompanying images and links. These include: 'Making the Most of Earth Science Data: The 2nd Gregory G. Leptoukh Online Giovanni Workshop' (November 10-14, 2014), 'NASA FIRMS Helps Fight Wildland Fires in Near Real-Time', 'Status of Rapid Response servers' (Rapid Response primary servers are up and are functioning normally), 'Webinar - Know Your Landsat: Understanding and Accessing Landsat Data' (October 8, 2014, 2:00 - 4:00 ET), 'New Products in the Global Imagery Browse Services' (AMSR-E Sea Ice and Blue Marble: Next Generation), and 'Toolsets for Airborne Data (TAD)' (a beta release of Toolsets for Airborne Data (TAD) is now available).



Where to Obtain MODIS Products

- ❑ ECHO Reverb
 - ❑ <http://reverb.echo.nasa.gov>
- ❑ Data Subsetting and Visualization: Oakridge National Lab DAAC (ORNL DAAC)
 - ❑ <http://daac.ornl.gov>
- ❑ GLCF
 - ❑ <http://www.landcover.org/data/lc>
- ❑ GLOVIS
 - ❑ <http://glovis.usgs.gov>
- ❑ Fire Information for Resource Management System (FIRMS)
 - ❑ <https://earthdata.nasa.gov/data/near-real-time-data/firms>



Where to Obtain MODIS Products

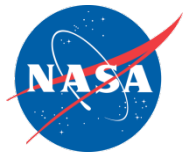
- ❑ Worldview (Fires, Land Surface Temperature and Snow Cover)
 - ❑ <https://earthdata.nasa.gov/labs/worldview/>
- ❑ Visualization: SERVIR
 - ❑ <https://www.servirglobal.net/Global/MapsData/InteractiveMapper.aspx>
- ❑ MRTWeb
 - ❑ <http://mrtweb.cr.usgs.gov>

Fire Information for Resource Management System (FIRMS)



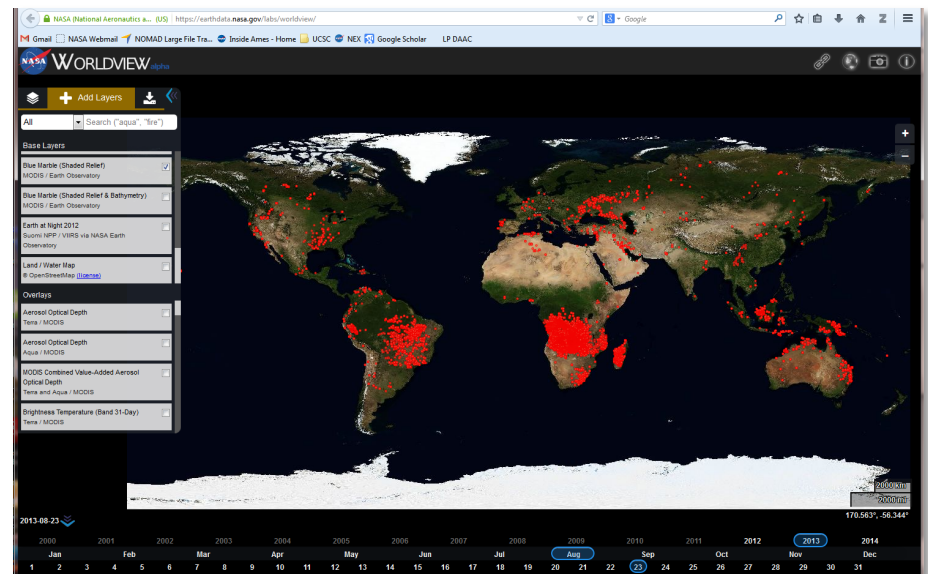
- ❑ Provides data for near real-time active fire locations using MODIS Fire Thermal Anomalies product.
- ❑ Provides historical data (older than 7 days) using the Archive Download Tool
- ❑ Obtain monthly MODIS Burned Area images from Web Fire Mapper
- ❑ Live demo at end of webinar

The screenshot displays the EOSDIS (Earth Observing System Data and Information System) website, specifically the 'Near Real-Time Data' section for the Fire Information for Resource Management System (FIRMS). The header includes the NASA logo, the EOSDIS name, and a search bar. The main navigation bar lists 'Data Tools', 'Data Centers', 'Near Real-Time Data', 'Standards and References', 'Our Community', 'User Resources', 'Labs', 'Wiki', and 'Register'. The 'Near Real-Time Data' section is highlighted, showing a sidebar with links to 'Data', 'Visualization', 'FIRMS' (with sub-links for Web Fire Mapper, MODIS Global Fire Maps, Fire Email Alerts, Active Fire Data, About, Background, Publications, and Links), 'Rapid Response' (with sub-links for Learn, About LANCE, FAQ, and Support), and 'GET DATA' (with sub-links for MODIS, AIRS, MLS, OMI, Platform, and Hazards and Disasters). The main content area features a 'Fire Information for Resource Management System (FIRMS)' heading, a description of FIRMS delivering global MODIS hotspots, a link to the MODIS Collection 5 Active Fire Product User's Guide, and a subscription link for the LANCE FIRMS mailing list. Below this are four featured sections: 'Download Data' (with a fire icon), 'Email Alerts' (with an envelope icon), 'Web Fire Mapper' (with a map icon), and 'Global Fire Maps' (with a globe icon). A 'NRT HIGHLIGHTS' section at the bottom shows a 'FIRMS Download MODIS fire data' link with a small globe icon.

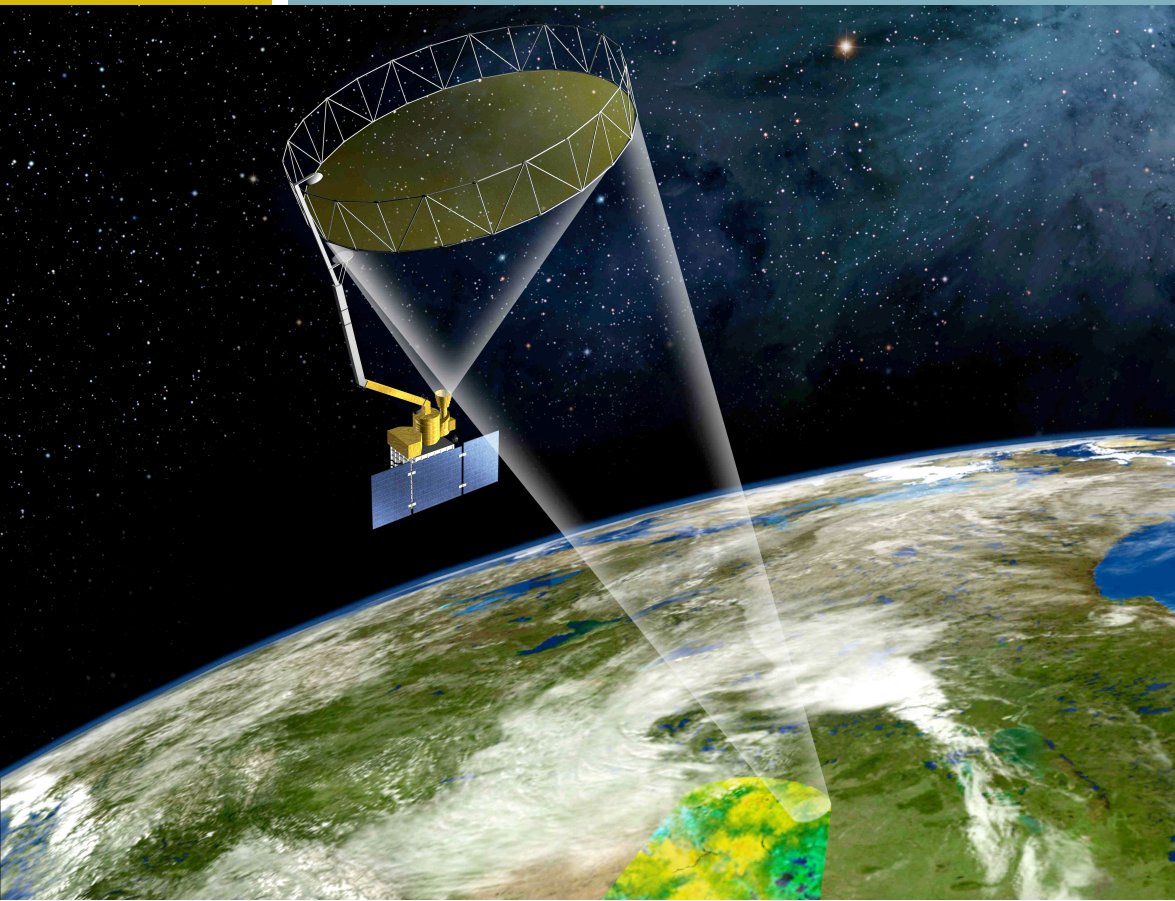


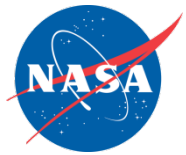
Worldview: Overview

- ❑ Online tool for browsing and downloading over 100 satellite-derived products
 - ❑ Products updated within three hours of observation
 - ❑ Contains base layers for viewing and overlays for data download
- ❑ Wide range of products available including:
 - ❑ Fires
 - (Day and Night)
 - ❑ Land Surface Temperature
 - (Day and Night)
 - ❑ Snow Cover
 - ❑ Ice Extent
 - ❑ Water Vapor
- ❑ Live demo at end of webinar

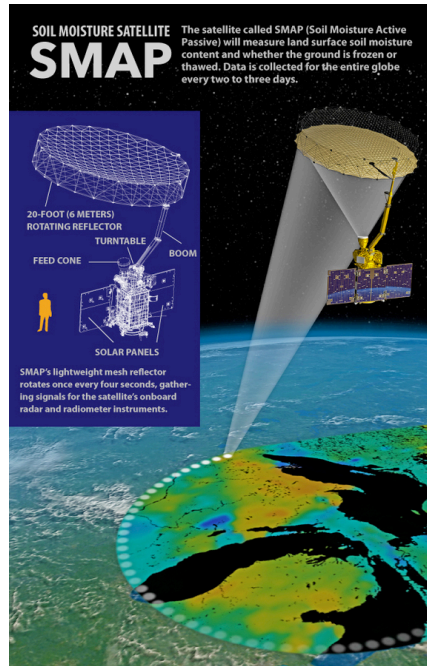


SMAP

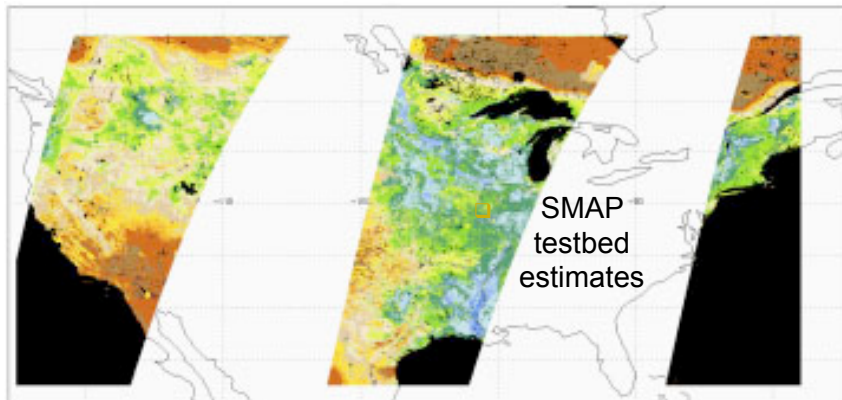




Soil Moisture Active Passive (SMAP)



- ❑ Designed to measure soil moisture every 2-3 days in the top 5cm (2 inches)
- ❑ Launched on January 31st, 2015
- ❑ Spatial Resolution
 - ❑ 3km
- ❑ Temporal Resolution
 - ❑ Every 2-3 days
- ❑ Data Format
 - ❑ Hierarchical data format – Earth Observing System Format (HDF-EOS)

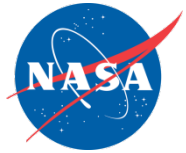


- ❑ Data will be available soon. For more information about data products and the product distribution portal visit:
<http://smap.jpl.nasa.gov/data/>
- ❑ More SMAP info during week 4

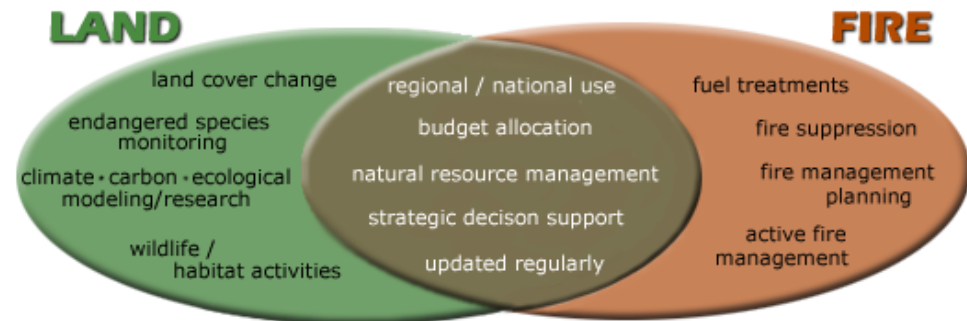
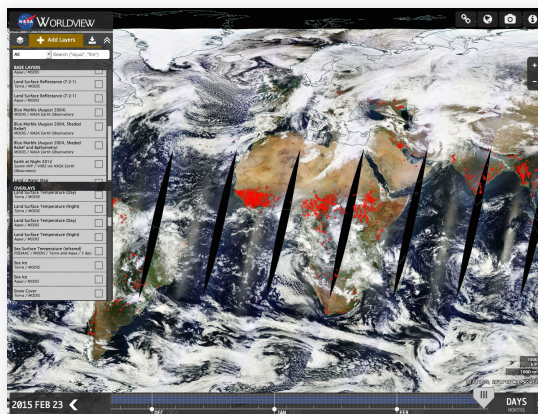
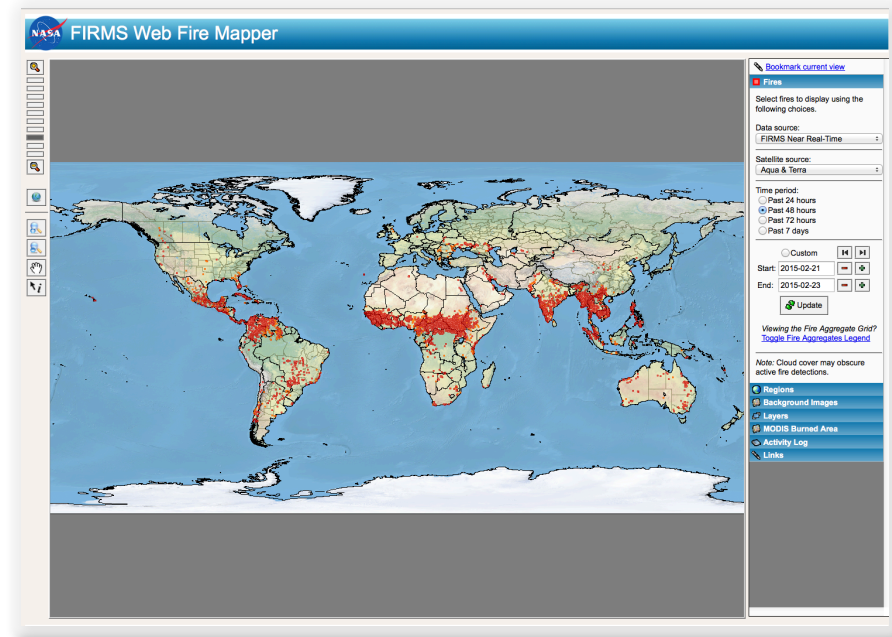


Wildfire Products and Tools

Wildfire Products and Tools



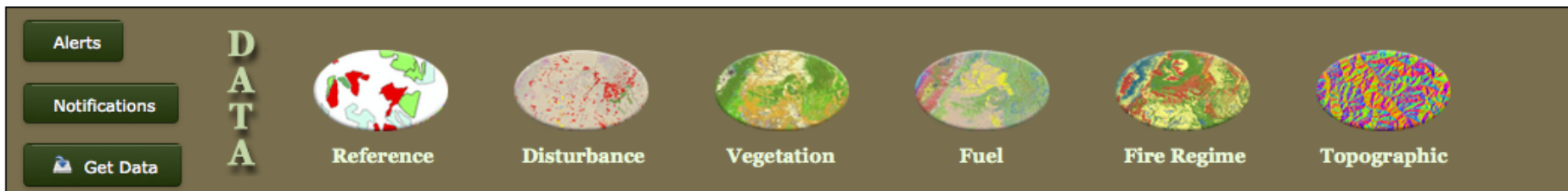
- ❑ LANDFIRE
- ❑ FRAMES
- ❑ FIRMS
 - ❑ Web Fire Mapper
 - ❑ Global Fire Maps
- ❑ Worldview



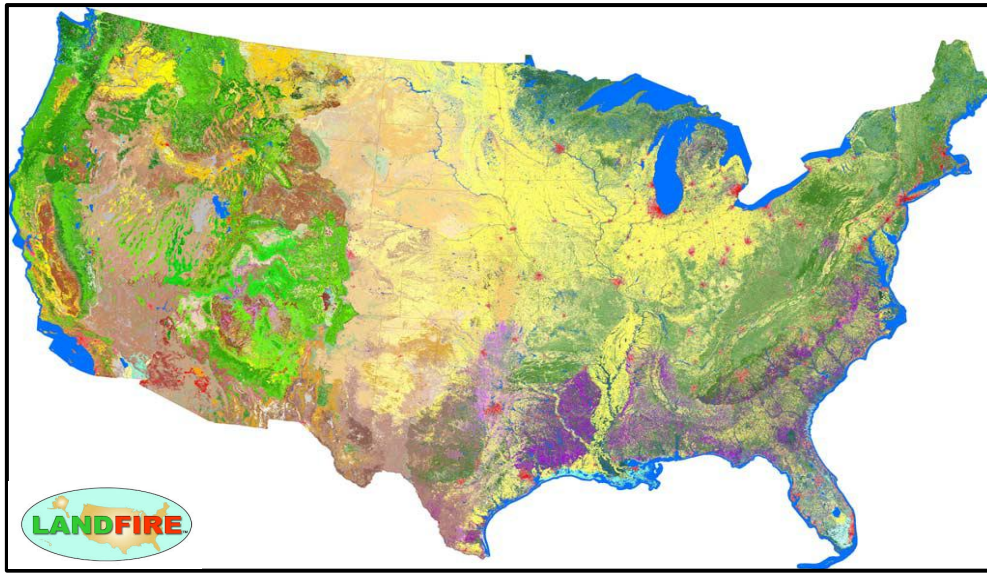
Landscape Fire and Resource Management Planning Tools (LANDFIRE)



- ❑ Joint program between wildland fire management programs of USDA Forest Service and US Department of Interior
- ❑ Provides consistent, comprehensive, geospatial data for vegetation, wildland fuel, and fire regimes in United States
 - ❑ Data and reports
 - ❑ Videos and tutorials
 - ❑ Decision-making tools



LANDFIRE Products

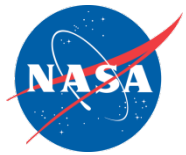


<http://www.landfire.gov>

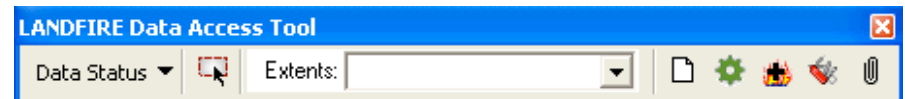
Products: Delivered at 30 m spatial resolution

- **Vegetation data layers** using Landsat imagery from 1999 - present
 - Current and historic vegetation composition and structure of the entire U.S.
- **Fuel and Fire Regime data layers**
 - Fire behavior and fuel loading models for entire U.S. 1999 -present
- **Disturbance data**
 - Fuel, vegetation, natural, and prescribed disturbance by type and year 1999-present

LANDFIRE Data Access Tool



- ❑ ArcGIS toolbar developed by the Rocky Mountain Research Station and distributed by Wildland Fire Management RD&A Fuels and Fire Ecology Program
 - ❑ Interact with LANDFIRE data directly from ArcMap
 - Select data
 - Define data extent
 - Download raster
 - ❑ The tool also allows you to:
 - Reproject the raster
 - Build a FARSITE landscape
 - Disassemble a FARSITE landscape back to original input
 - Attach database file
 - ❑ <http://www.landfire.gov/datatool.php>



LFDAT	10.2	LANDFIRE Data Access Tool 2.5 Downloads LANDFIRE data directly from ArcMap version 10.2 Prior to contacting the help desk, please refer to the LFDAT User Guide or the LFDAT FAQs page.	LFDAT 2.5 (zip) LFDAT Tutorial (zip) LFDAT User's Guide (pdf) LFDAT FAQs
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Fire Research and Management Exchange System (FRAMES)



- ❑ Provides a method of exchanging information and transferring technology among wildland fire researcher, managers, and other stakeholders in an online environment

- ❑ Online Courses:
<https://www.frames.gov/onlinecourses/>

A screenshot of the FRAMES Online Course System website. The header includes the "Frames Online Course System" logo and the University of Idaho. A navigation bar shows "FRAMES OCS" and a login status "You are not logged in. (Log in)". The main content area features a section for "WFMRD (NIFTT) Courses" with a description and a "Read More" button. Below this is a "Courses" section with a grid of course categories: WFMRD (NIFTT) Courses, FRCC Courses, LANDFIRE Courses, NWCG Courses, Emissions and Smoke, and Univ. of Id. Courses. On the left side, there are sidebar widgets for "REGISTRATION", "HELPSK", "NAVIGATION", and "CALENDAR". The calendar shows the month of March 2015.

Live Demos

**Fire Information for Resource
Management System (FIRMS):**

<https://earthdata.nasa.gov/data/near-real-time-data/firms>

NASA Worldview:

<https://earthdata.nasa.gov/labs/worldview/>

Coming up next week!

**Week 3: Remote sensing products
for pre- and post wildfire planning
and assessment**

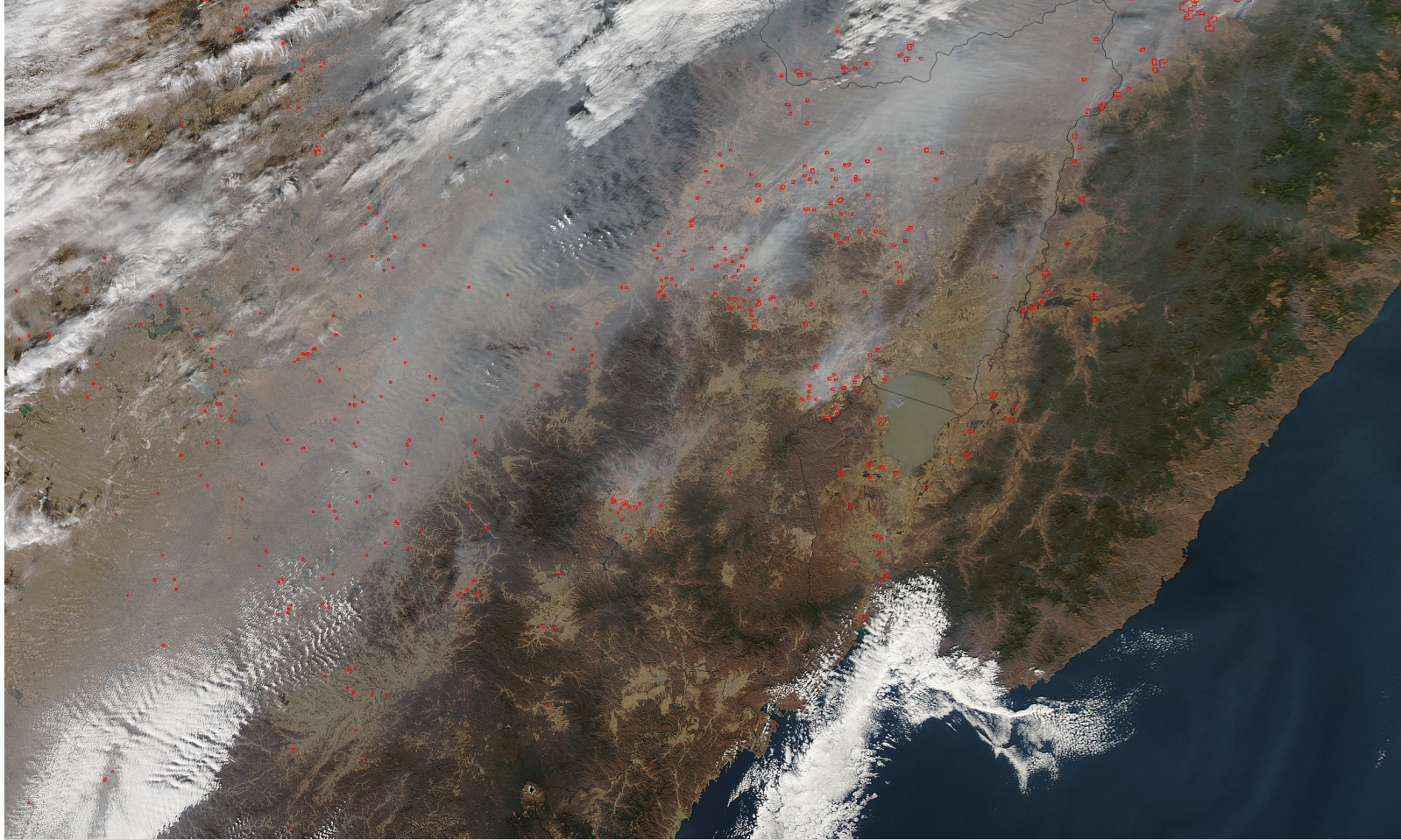


Important Information

- ❑ One lecture per week – every Tuesday from March 31 to April 28 (11:30 AM – 12:30 PM EST)
- ❑ Webinar recordings, PowerPoint presentations, and homework assignments can be found after each session at:
<https://arset.gsfc.nasa.gov/disasters/webinars/introduction-remote-sensing-wildfire-applications>
- ❑ Certificate of Completion
 - ❑ Attend 4 out of 5 webinars
 - ❑ Assignment 1 and 2 – access from the ARSET wildfire webinar website (above)
 - ❑ You will receive certificates approximately 1 month after the completion of the course from: marines.martins@ssaihq.com
- ❑ Q/A: 15 minutes following each lecture and/or by email (cynthia.l.schmidt@nasa.gov)

MODIS
image of
small fires,
smoke and
haze in
eastern
China.

November
3, 2014



Thank You!!

Cindy Schmidt
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